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EXPERIMENTAL INVESTIGATION ON STRENGTH OF REINFORCED CEMENT CONCRETE BY USING SUGAR CANE BAGASSE ASH

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Abstract - *The utilization of waste material as mineral admixture in cement provides a satisfactory solution to some of the environmental concerns and problems associated with waste management. Agro waste such as Sugarcane Bagasse Ash (SCBA) is one among such a potential material. Utilization of industrial and agricultural waste products in the industry has been the focus of research for economic, environmental, and technical reasons. Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapor. This waste-product is already causing serious environmental pollution which calls for urgent ways of handling the waste. In this paper, Bagasse ash has been chemically and physically characterized, in order to evaluate the possibility of their use in the industry. The investigation program included the partial replacement of cement by bagasse ash by 10%, 15% and 20%. And also influence of CO2 while cement production and the reasons of replacements of cement by bagasse ash. The various types of test which can be performed are also discussed. The strengths of normal cement mix and bagasse added samples are been compared graphically. The above study indicates that an increase in Compressive Strength and Flexural Strength of reinforced cement concrete for 15 % replacement of cement with Bagasse ash.*

Key words: sugarcane bagasse ash, partial replacement, compressive strength, flexural strength.

1. INTRODUCTION

Currently, many countries are using pozzolanic materials in concrete structures for improving compressive strength and reducing the cost of concrete. Many pozzolanic materials such as fly ash, silica fume, rice husk ash, sugar cane bagasse ash, palm oil fuel ash, etc., have been improved and used to replace cement in concrete. Concrete consists of cement, aggregates, water, and eventually, mineral and chemical admixtures. When all these materials are mixed, cement particles in contact with water undergo a hard-ening reaction that bonds the aggregates together. It is the most common construction material in the world because it combines very good mechanical and durability properties, workability, versatility, and relative low cost. However, cement production emits greenhouse gases, mainly CO_2, being responsible for about 5% of global anthropogenic CO_2 emissions in the world. Since 1.00kg of cement produces approximately 1 kg of CO_2 [1], the use of low emission pozzolans as cement replacement is one of the possibilities to reduce greenhouse gases emissions. Cement is manufactured in more than 80 countries and the most commonly used cement is Ordinary Portland Cement (referenced as OPC). For its production, limestone mixed with clays and small quantities of other materials need to be heated up to 1450 ^{0}C. As a result of this process, clinker (about 95% in mass) is obtained. The clinker is then ground and mixed to gypsum (about 5% in mass). The main pozzolans currently used in cement industry are fly ash, a by-product of coal-fired power plants, and silica fume, a by- product of metallurgical processes. Other pozzolans have also been used in a reduced scale, such as natural pozzolans, metakaolin, and agro-industrial ashes such as rice husk and sugar cane bagasse ashes. Sugar cane bagasse, the fibrous residue after crushing and juice extraction of sugar cane, is a major industrial waste product from the sugar industry in Thailand. Nowadays, it is commonplace to reutilize sugar cane bagasse as a biomass fuel in boilers for vapor and power generation in sugar factories. Depending on the incinerating conditions, the resulting sugar cane bagasse ash (SCBA) may contain high levels of SiO_2 and Al_2O_3, enabling its use as a supplementary cementitious material (SCM) in blended cement systems. The use of SCBA as an SCM to partially replace ordinary Portland cement not only helps reduce methane emissions from disposal of the organic waste and reduce the production of cement, which is infamous for its high energy consumption and CO_2 emission, but also can improve the compressive strength of cement-based materials. Engineering achievements have always been closely associated with the availability of suitable materials for construction. Further progress of engineering will depend on continuous development of all forms of construction materials. Ever since concrete have been accepted as a material for construction. Engineers are trying to improve its quality, strength, etc. against adverse condition. The aim of the engineers is to make the concrete not only everlasting but also an economical material of construction to steel, timber, etc. and to improve its properties various techniques were adapted to make to make concrete as versatile material in all aspects.

2. MATERIAL USED

Material used in this study are(I) Portland pozzolana cement (ii) sugarcane bagasse (iii)coarse aggregate. All these material are locally available.

Table-1: Properties of Cement

S.NO	properties	results	Nominal values as per IS 1489-1991
1	Standard consistency		26%-33%
2	Initial setting time(min)		Min 30
3	Final setting time(min)		Max600

Table-2: Properties of Sugarcane

S.NO	Test particulars	sugarcane	Nominal values as per IS 2386-1963
1	Specific gravity		2.2-3.2
2	Water absorption		2.4-2.9
3	Grading zone		-
4	Maximum size		-

Table-3: Properties of Sand

S.NO	Test particulars	sugarcane	Nominal values as per IS 2386-1963
1	Specific gravity		2.2-3.2
2	Water absorption		2.4-2.9
3	Grading zone		-
4	Maximum size		-

Table-4: Properties of Coarse Aggregate

S.NO	Test particulars	sugarcane	Nominal values as per IS 2386-1963
1	Specific gravity		2.2-3.2
2	Water absorption		2.4-2.9
3	Grading zone		-
4	Maximum size		-

PREPARATION OF CONCRETE SPECIMENS

A grade of concrete is used in the test [2] with a water cement ratio of 0.45 [3] according to IS 459-2000. The specimens were prepared in the following size moulds: (i) be 150mm x 150mm x 150mm and 300mm height (iii) prism 100mm x 100mm x 500mm [4]. Specimens were cast with conventional concrete.

3. CONCRETE TESTING

1. Slump cone test

The slump cone test is used to assess the horizontal flow of in the absence of obstructions [5]. Mould is the pipe of a truncated cone with internal dimensions 200 in diameter at the base, 100mm. concrete is poured in three layers and a cone is lifted in an upward direction. The difference in height of cone to the remaining concrete gives the slump use.

2. Compressive Strength Test

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its The compression test is carried out on specimens cubical or cylindrical in shape. Prism is also sometimes used, but it is not common in our country. Sometimes, the compression strength of concrete is determined using parts of a beam tested in flexure. The end parts of beam are left intact after failure in flexure and, because the beam is usually of square cross section, this part of the beam could be used to find out the compressive strength.

The cube specimen is of the size 150 x 150 x 150 mm. If the largest nominal size of the aggregate does not exceed 20mm, 100mm size cubes may also be used as an alternative. Cylindrical test specimens have a length equal to twice the diameter. They are 150mm in diameter and 300mm long. Smaller test specimens may be used but a ratio of the diameter of the specimen to maximum size of aggregate, not less than 3 to 1 is maintained.

Procedure:

1. Take a dimensions of the concrete Cubes or Cylinder.
2. Placed the concrete Cubes or Cylinder in the C.T.M.
3. Switch on the machine and use the UP & DOWN buttons for fixing the Cubes or Cylinder.
4. Then switch ON the HYDRAULIC button and close the OUTLET valve and open the INLET valve
5. Increase the load pressure by opening the inlet valve
6. Then record the maximum load

Calculate the compressive strength of concrete Cubes or Cylinder.

Table-4 Compessive Strength Test

Compressive strength test	7days	14days	28days
0% WO Ash	35.16	42.51	50.52
10% W Ash	37.32	45.33	54.10
15% W Ash	41.11	48.87	57.99
20% W Ash	29.44	35.97	39.54

3. Flexural Strength Test for Beam

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress, here given the symbol f_b. The flexural and splitting tensile strengths shall be obtained as described in IS 516 and IS 5816 respectively. When the designer wishes to use an estimate of the tensile strength from the compressive strength, the following formula may be used:

Flexural strength, $f_b = 0.7\sqrt{f_{ck}}$ N/mm^2

Where f_{ck} is the characteristic cube compressive strength of concrete in N/mm^2.

Procedure:

1. Test specimens are stored in water at a temperature of 24° to 30°for 48 hours before testing.
2. They are tested immediately on removal from the water from the water whilst they are still in a wet condition.
3. The dimension of the specimen should be noted
4. Place the specimen in the flexural testing machine
5. Apply the load
6. Record maximum load

The Flexural Strength of the specimen is expressed as the modulus of rupture f_b which if ‘a’ equals the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen, in cm, is calculated to the nearest 0.05 MPa as follows:

When ‘ a ’ is greater than 20.0 cm for 15.0 cm specimen or greater than 13.3 cm for a 10.0 cm specimen, or

When ‘ a ’ is less than 20.0 cm but greater than 17.0 cm for 15.0 cm specimen or less than 13.3 cm but greater than11.0 cm for a 10.0 cm specimen where

b = Measured width in cm of the specimen

d = Measured depth in cm of the specimen at the point of failure

l = Length in cm of the span on which the specimen was supported

p = Maximum Load applied to the specimen

If 'a' is less than 17.0 cm for 15.0 cm specimen, or less than 11.0 cm for a 10.0 cm specimen, the results of the test be discarded.

Table-5 Flexural Strength Test

flexural strength test	7days	14days	28days
0% WO Ash	5.38	5.92	6.01
10% W Ash	5.55	6.12	6.58
15% W Ash	5.82	6.35	7.15
20% W Ash	4.93	5.45	4.37

4. DISCUSSION

Physical test on conducted in Cement, SCBA, Fine Aggregates and Coarse Aggregates.

- The test results show that there is an increase in compressive strength of concrete for 15 % replacement of cement with Bagasse ash.
- The test results show that there is an increase in flexural strength of concrete for 15 % replacement of cement with Bagasse ash.
- Preliminary investigations with SCBA demonstrate that it presents appropriate chemical composition for application as a pozzolon.

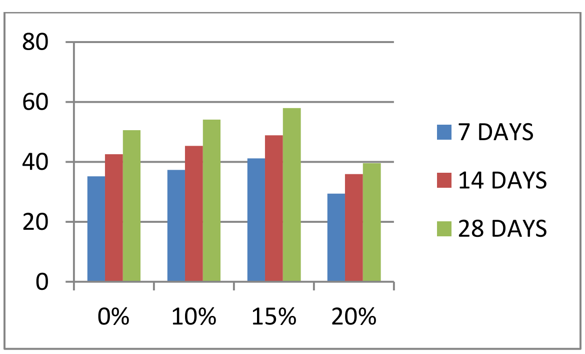

Chart-1 Compessive Stength Test

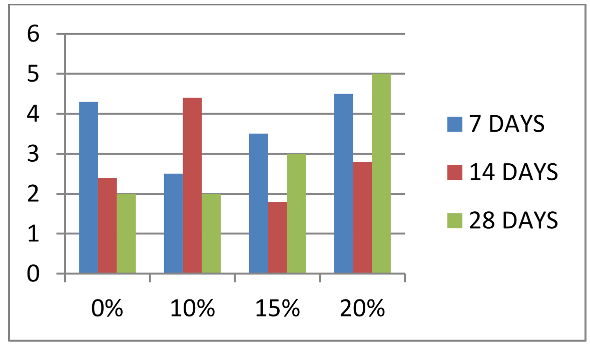

Chart-2 Flexural Stength Test`

5. CONCLUSIONS

- Utilization of industrial and agricultural waste products in the industry has been the focus of research for economical, environmental, and technical reasons.
- Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour.
- In this paper**,** Bagasse ash has been physically characterized, in order to evaluate the possibility of their use in the industry.
- Bagasse ash has good potential for cement replacement.
- Common sugar is one of the most effective retarding agents used as an admixture for delaying the setting time of concrete without detrimental effect on the ultimate strength.
- Thus Bagasse ash contributes to reduce both environmental and economical problems that would be associated with their disposal.

REFERENCES

1. **Hassan Tanoursaz & Mojtaba Labibzadeh**, Comparison of Uniaxial Compressive Strength of Light Weight Concrete Prepared with Bagassese between Cubic and Cylindrical Specimens Civil Engineering Department, Islamic Azad University, Dezful Bearnch, Iran, Journal of American Science, 2011;7(2)

2. **G. C. Cordeiro, R. D. Toledo Filho & E. M. R. Fairbairn,** Ultrafine Sugar Cane Bagasse Ash: High Potential Pozzolanic Material for Tropical Countries Laboratory of Civil Engineering, Center of Science and Technology, Universidad Estadual do Norte Fluminense Darcy Ribeiro, Campos dos Goytacazes-RJ, Brazil, IBRACON Structures and

materials journal, Volume 3, Number 1 (March, 2010) p. 50 - 67 • ISSN 1983-4195.

3. **Eduardo M. R.** Durability of Concretes Containing Sugar Cane Bagasse Ash Fairbairn Universidade federal do Rio de Janeiro – COPPE – Department of Civil Engineering.

4. **V. S. Aigbodion, S. B. Hassan, T. Ause and G.B. Nyior,** Potential Utilization of Solid Waste (Bagasse Ash) Department of Metallurgical and Materials Engineering, Ahmadu Bello University, Samaru, Zaria, Nigeria. Journal of Minerals & Materials Characterization & Engineering, Vol. 9, No.1, pp.67-77, 2010.

5. **Lavanya M.R, Sugumaran.B, Pradeep.T,** An Experimental study on the compressive strength of concrete by partial replacement of cement with sugarcane bagasse ash, International Journal of Engineering Inventions, Volume 1, Issue 11 (December2012).

6. **Mrs.U.R.Kawade, Mr.V.R.Rathi, Miss Vaishali D. Girge,** Effect of use of Bagasse Ash on Strength ofConcrete, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 7, July 2013.

7. **G.Sivakumar, V.Hariharan and S.Barathan,** Preparation of Bio-cement using sugarcane bagasse ash and its Hydration behaviour, International Journal of Science, Engineering and Technology Research (IJSETR), Volume 2, Issue 10, October 2013.

8. **Kanchan Lata Singh and S. M. Ali Jawaid,** Utilization of Sugarcane Bagasse Ash (SCBA) as Pozzolanic Material in Concrete: A Review, IJBSTR REVIEWPAPER, VOL 1 [ISSUE 8] AUGUST 2013

9. **R.Srinivasan and K.Sathiya,** Experimental Study on Bagasse Ash in Concrete, International Journal for Service Learning in Engineering, Vol. 5, No. 2, pp. 60-66, Fall 2010

10. **Dr. N. Mahendran and M. Sivakumar,** Expermintal Studies of Strength and Cost Analysis of Concrete Using Bagasse ASH, International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 4, April – 2013

11. **Guruvaiya. G, Mercy Shanthi.R and Sheela. V,** A Study On Optimising The Strength Of Concrete Using Green Materials, International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 3, March - 2013

12. **SANTHAKUMAR.A.R** "CONCRETE TECHNOLOGY" OXFORD UNIVERSITY PRESS, NEW DELHI.

13. **SHETTY.M.S** "CONCRETE TECHNOLOGY" S.CHAND &COMPANY LIMITED, NEW DELHI.

14. **IS: 456-2000** "CODE OF PRACTICE FOR PLAIN AND REINFORCED CONCRETE".

15. **IS: 10262-2009** "CONCRETE MIX PROPORTIONING – GUIDELINES" (FIRST REVISION).